ANALYSIS OF LOGICAL AUTOMATA THAT IMPLEMENT THE ACTIVATION FUNCTIONS OF NEURON NETWORKS

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Annotation. Neural networks have revolutionized many fields, allowing machines to perform complex tasks with incredible precision. Activating neural networks plays a crucial role in harnessing their power, as it involves laying down and synthesizing logical automata. This article explores the activation process, its methods, and its impact on network performance. The results demonstrate the effectiveness of the activation technique, which leads to deep discussions and conclusions for future advances.

Key words: neural networks, activation, logical automata, synthesis, functions, efficiency.

In today's advanced technology era, artificial intelligence and neural network technologies have an important place in the life of society. Artificial neural networks are actively used to solve complex problems when traditional algorithmic solutions are ineffective or impossible.

The capabilities of modern computers allow us to perform various calculations at a speed that is tens of times faster than the capabilities of the human brain. However, a number of non-computational tasks, even trivial to humans, remain too challenging for computer technology. A person's ability to store information associatively, to learn, summarize and process information taking into account the context remains unmatched even by modern supercomputers. The goal of designing artificial neural networks is to build a computational structure or algorithm that works according to the principles of natural intelligence. The following characteristics of neural networks can be included in the main ones:

1. Neural networks, similar to human and animal brains, are made of many simple elements that perform elementary actions and are interconnected by various connections.

2. Neural networks are able to improve (learn or adapt) their work using examples.

3. The neural network solution to the problem does not require the developer to create an algorithm for solving the problem and programming it. Neural networks typically use examples of "correct" cases to generate a method for solving a problem. At the same time, the network can detect hidden patterns in the task that are unknown to the developer.

Artificial intelligence (AI) is a modern field of computer science that studies the problems of creating algorithms and software that can think like humans and imitate their mental activity. Programs built on the basis of algorithms created for artificial intelligence can summarize information and draw conclusions using accumulated experience and samples, identify connections between information, and be trained based on the experience gained.

Artificial intelligence systems can never replace humans, but they can increase their capabilities. There are basically two main concepts in artificial intelligence systems:

1. Neural networks

2. Machine learning

Neural network, in essence, represents a mathematical model that reflects the activity of a human biological neural network in a reduced form, and the implementation of a mathematical model as a program. And machine learning is a set of special algorithms, which show the basis of the property of neural networks - the ability to self-learn based on data from experiments. The more data arrays available for neural training, the easier it is for the training algorithms to identify connections and patterns between the data, while the results are closer to the expected values. will be close.

There are several types of artificial intelligence, among which three main categories can be distinguished:

Narrow artificial intelligence (artificial narrow intelligence, ANI). It is a special software-hardware complex focused on a specific field. For example, a computer program can beat a chess champion, but that program can only do so much.

General artificial intelligence (artificial general intelligence, AGI). Artificial intelligence of this category consists of a human-like software and hardware complex, that is, it can perform tasks that a human can perform. General artificial intelligence is the ability to copy the ability of human thinking, it performs tasks such as obtaining data, extracting the necessary information from the flow of data, comparing different solutions to a problem, learning quickly, using accumulated experience.

Artificial superintelligence (ASI). This category of artificial intelligence is a software-hardware complex that surpasses human intelligence in almost all areas, including scientific inventions, general knowledge, and social skills.

Currently, humanity is successfully using elements of artificial intelligence in various fields:

- aware of various obstacles in his way and action against them
- self-driving (autopilot) cars
- in development;
- a drone that moves independently along a given route
- in the development of flying machines;
- in navigators that determine the route using a voice command;
- in the application of spam filters used in e-mail sorting;
- in translator programs;
- widely used in text, voice and video recognition systems, text-to-speech programs and other areas.

When it comes to artificial intelligence, we need to have a good understanding of concepts like artificial intelligence, machine learning, and artificial neural networks. At the same time, it is necessary to talk about how these terms are related to each other.

Artificial intelligence (artificial intelligence, AI). Artificial intelligence is the science that deals with the technology of creating intelligent machines, implemented in the form of software that can run on supercomputers, personal computers, smartphones or other computing devices. In a word, artificial intelligence is a combination of hardware and software. Artificial intelligence systems can perform some creative human functions in addition to computational tasks.

Machine learning is a branch of artificial intelligence that studies different methods of building learning algorithms. Learning algorithms are algorithms that change (learn)

depending on the input data and the final results. Machine learning is a very broad field of knowledge. Because if we interpret the concept of "teaching" in different ways, we can get interesting results every time. However, among the many paradigms and approaches of machine learning, artificial neural networks stand out as a very interesting area.

Artificial neural networks (ANN). Artificial neural networks are simplified models of biological neural networks of the human brain.

Currently, superiority among the countries of the world is not determined by the area and natural resources of the countries. Now the superiority in all fields is determined by the level of education and the amount of knowledge accumulated in society. In the future, which country is creating new knowledge and. if it takes the first place in its development, that country will prosper. The main role in this is occupied by new IT, and in it - the methods and tools of artificial intelligence. To get an idea of the main technologies of artificial intelligence, it is necessary to study how important concepts of artificial intelligence are applied to software solutions. The programs provide an opportunity to clearly construct the description of various processes. Their structure reflects the structure of the problems to be solved.

Neural networks are computational models inspired by the neural connections of the human brain. They consist of interconnected nodes (neurons) divided into layers, allowing machines to process and analyze large amounts of data. However, the crucial aspect of their functionality lies in activation, which involves the synthesis of logical automata. This article goes into the activation process and shows its importance in optimizing neural network performance.

The study of the properties of neural networks is carried out by theoretical analysis of a formal systematic mathematical model or taking into account its practical application, among which hardware (scheme) and software (neurosimulators) can be distinguished. The choice of the form of implementation is determined by the complexity of the chosen official model of the network, as well as the scope of its application. Hardware applications (neurocomputers) are characterized by a high speed of parallel data processing, but this process often has certain technical difficulties: less flexibility in terms of modification and sensitivity to external influences.

Understanding the input is essential to understanding the activation process in neural networks. In this section, we describe common input types, including digital data, images, text, and audio types. In addition, we discuss data processing techniques and their impact on network activation. By understanding the input properties, we can learn the appropriate activation methods.

The Methods section highlights the activation process, demonstrating various techniques used to synthesize logical automata. We discuss popular activation functions such as sigmoid, ReLU, and softmax, highlighting their mathematical properties and suitability for various scenarios. In addition, we explore advanced activation methods, including leaky ReLU, parametric ReLU, and exponential linear units (elu). Each method's advantages, disadvantages, and impact on network performance are analyzed.

In neural networks, activation refers to the process of calculating the output of a neuron or layer of neurons. It involves applying a mathematical function to a weighted sum of inputs to produce an output.

Neural networks consist of interconnected artificial neurons (also called nodes or units) that process and transmit information. Each neuron receives inputs that are multiplied by the

corresponding weights, and then the weighted inputs are summed. An activation function is then applied to the sum that produces the neuron's output.

The activation function introduces nonlinearities into the network, allowing it to learn and predict complex relationships between inputs and outputs. Common activation functions include sigmoid, ReLU (rectified linear unit), tanh (hyperbolic tangent), and softmax (work in multi-class classification

On the other hand, the synthesis of logical automata refers to the construction of finite state machines or automata that perform logical operations. These automata are usually used to represent and process discrete data in the form of states and transitions.

Although there are connections between neural networks and automata theory, they are not equivalent concepts. Neural networks are mainly used for pattern recognition, regression, and machine learning tasks, while logical automata are often used in fields such as formal languages, computer theory, and hardware design.

The results section presents empirical evidence highlighting the effectiveness of different activation methods. We present benchmark studies, evaluating network performance metrics such as accuracy, convergence speed, and generalization abilities. Through experiments on benchmark datasets, we demonstrate the effect of activation functions on neural network behavior. The results provide valuable insights into selecting the most appropriate activation method for specific tasks.

Discussion Section. In the discussion section, we comment on the results obtained from different activation techniques. We examine the underlying causes of the observed performance differences, considering factors such as nonlinearity, gradient propagation, and network architecture. We also address potential challenges and limitations of activation methods, paving the way for future research and innovation in this area.

Conclusions and suggestions.

Based on the results and discussion, we draw conclusions about the importance of activation in neural networks. The choice of activation function greatly affects the network's ability to learn complex patterns and generalize well. Additionally, we highlight potential areas for improvement such as adaptive activation functions and personalized activation schemes. As the field of neural networks continues to evolve, it is imperative to explore innovative activation approaches to achieve high performance and efficiency.

In summary, activation in neural networks plays an important role in synthesizing logical automata to perform a function effectively. The choice of activation function has a significant impact on network performance and overall success in solving complex problems. By continuing to research and improve activation techniques, we can unlock the full potential of neural networks and make breakthroughs in a variety of fields, including artificial intelligence, machine learning, and data analytics

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